Photonic Crystal Dispersion Compensators

M. Kamp[1], J. Zimmermann[1], B.K. Saravanan[2], S. Anand[3], R. März[2] and A. Forchel[1]

[1]Technische Physik, Universität Würzburg, Am Hubland, 97074 Würzburg, Germany
[2]Infineon Technologies AG, Corporate Research, 81730 Munich, Germany
[3]Royal Institute of Technology, Electrum 229, Kista 16440, Sweden

We have realized tunable dispersion compensators based on photonic crystal (PhC) waveguide Fabry-Pérot resonators. The resonators are formed by two PhC sections acting as partial reflectors in a linear defect waveguide. The PhC consists of a triangular lattice of air holes etched into a passive InGaAsP/InP heterostructure with a lattice constant a = 400 nm and an air filling factor of 35 %. Characterization was performed at 1.5 µm wavelength with an external tunable laser source. The transmission of the resonators shows periodic Fabry-Perot resonances with 100 GHz channel spacing and quality factors up to 15,000.

The group delay of the devices was measured using a phase shift technique. The light of the tunable laser source was modulated at 3 GHz using a $LiNbO_3$ Mach-Zehnder modulator. A phase sensitive detection of the transmitted light is used to obtain the phase shift of the modulated signal, which is proportional to the group delay. The derivative of the group delay as a function of the probe wavelength gives the group velocity dispersion. We obtain values ranging from –250 ps/nm to +250 ps/nm at wavelengths around 1.55 µm, sufficing to compensate for the dispersion of 15 km standard single-mode fiber. A temperature variation of only $\Delta T = 7\ ^\circ C$ corresponding to a variation of the effective refractive index of $\Delta n \approx 2\times10^{-3}$ is sufficient to tune the resonator curve over the full free spectral range of 100 GHz.